TRAINING FENCES FOR SANDY-STREAM CHANNELS --A METHOD OF DIRECTING BASE FLOW TO IMPROVE DISCHARGE RECORDS

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ABSTRACT

A training fence is a barrier consisting of angle iron and chicken wire designed to deflect the direction of streamflow at low stages toward and over the orifice for stage recorders. These fences have been used successfully by the Agricultural Research Service at the Southern Great Plains Watershed Research Center in Chickasha, Okla., to improve the accuracy of low-flow discharge records in sandy-stream shannels. These fences cost about $147 per 100 feet.

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Training Fences for Sandy-Stream Channels --A Method of Directing Base Flow to Improve Discharge Records

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USE OF TRAINING FENCES IN GAGING STATIONS

The constant meandering of a low-flow channel within the main channel of streams with sandy bottoms prevents locating the orifice for stage recorders at a permanent position in the main channel. In sandy channels, the orifice must be relocated periodically to maintain a low-flow stage record. However, by the use of training fences the low-flow channel can be directed to and maintained at any desired point in the streambed (figs. 1 and 2). Thus training fences will allow the stage recorder to be located permanently in the main channel, eliminating the expense and inconvenience of moving the orifice. Training fences also improve the accuracy of discharge records by reducing and stabilizing the width of the low-flow channel, thus assuring a continuous water-level record that can be related to a stable

Figure 1.—Training fences directing flow to the orifice (A) for a bubble gage at a weir-control station. The broken lines point out the location of the training fences.

Figure 2.—Training fences directing flow to the orifice (A) for a bubble gage at a channel-control station. The broken lines point out the location of the training fences.

The training fence consists of a series of angle-iron posts set 4 feet apart in a straight line and jetted[2] to a depth of 12 to 14 feet. The tops are not more than 1 foot nor less than 0.5 foot above the water surface at mean low flow. The fence has two strands of No. 9 galvanized wire stretched along the upstream face and fastened securely to the angle iron. These two wires are placed 1 foot apart, with the top wire at the top of the angle-iron posts. One-inch-mesh chicken wire, 1.5 feet high, is stretched along the upstream face of the fence and fastened securely to the angle iron and the wires. Angle-iron ribs are then securely fastened horizontally across the upstream face near the top of the fence (fig. 3). The ribs protect the chicken wire from logs or other objects.

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[2] A process by which the angle iron is placed parallel to a pipe, and the pipe and angle iron forced into the ground by the hydraulic action of water being pumped through the pipe.

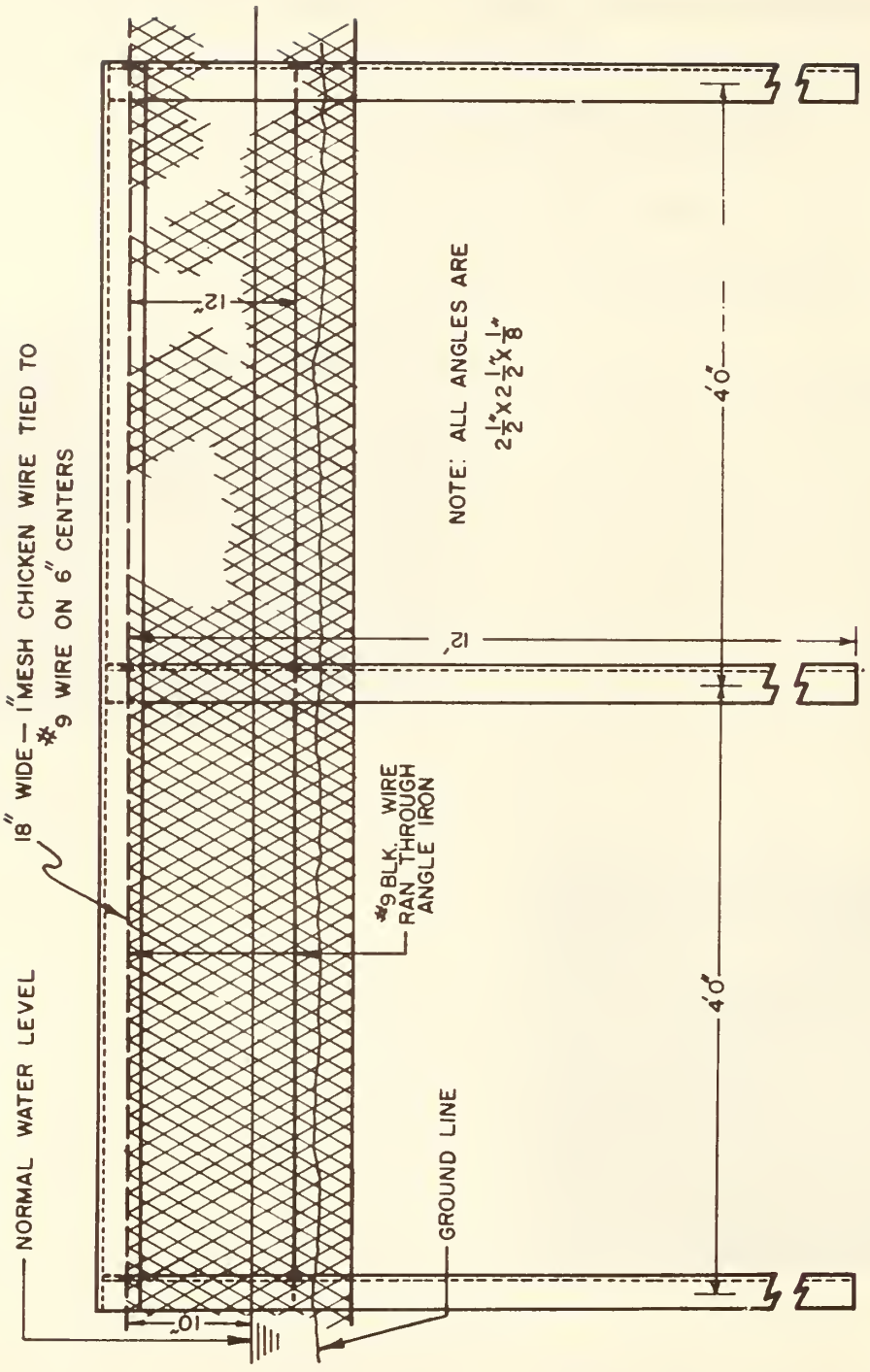

Figure 3.—Details of training fence (view of upstream side).

POSITION AND LENGTH OF TRAINING FENCES

The position and length of most training fences will be controlled by the location of the stage recorder orifice and the desired width of the low-flow channel. Previous knowledge of the changes that occur during and after runoff events is of great value in deciding where to install the upstream member in a series of training fences. The originating point (upstream end) of the upstream member in a series of training fences is best located at a point where the low-flow channel commonly or permanently occurs and close to a bank. From the originating point, the fence should run directly toward the orifice; therefore, if the angle of incidence between the flow line and the fence is not more than 30 degrees, the point where the low-flow channel commonly or permanently occurs would be a satisfactory originating point. If the angle of incidence is greater than 30 degrees, the fence should be positioned as outlined in the following paragraph. Thirty degrees is about the maximum angle that a training fence can deflect the water at low flow (fig. 4). If a satisfactory stable point in the low-flow channel can be found, a series of training fences only on the side of the channel from which the flow is to be deflected will be required.

If a stable point in the low-flow channel does not exist, a series of training fences on both sides of the channel will be required. Here, the originating point of the upstream member in a series of training fences must be along a bank. The distance upstream can be determined from the width of the natural channel and the orifice location. As a "rule of thumb," the distance upstream from the orifice to the originating point on each side of the stream should be about three times the distance from the orifice to the bank on that side (fig. 5).

When the originating point has been determined, the first of the series of fences is constructed along a line projected from the originating point to the orifice. The fence should extend downstream from the originating point to about one-half the distance to the orifice, or to a point where the fence intersects the desired low-flow channel upstream and perpendicular to the gaging sections, whichever is shorter (fig. 5). A second fence should originate along the bank a distance upstream from the orifice equal to three-fifths the distance from the orifice to the originating point of the first fence (fig. 4). This will allow the two fences to overlap by about one-fifth the length of the first fence. The second fence should be laid out in the same manner as the first one except that it should end at the edge of the desired low-flow channel.

Generally, streams with high velocities (7 to 11 feet per second) during major runoff events will require one or two backup fences set 5 to 10 feet downstream and parallel to the major fences (fig. 5).

Low flow will follow the desired path after the first runoff event. In most sandy-bottom streams with aggrading or degrading beds, or with fluctuating bed elevations, the fences will need periodic maintenance. If bed elevation changes drastically, they may even need to be replaced. Maintenance of the fences will usually involve flushing of the desired low-flow channel, or installing accessory fences to aid in deflecting the flow.

METHOD OF INSTALLATION

The training fence should be constructed as follows:

1. Jet angle-iron posts, 2½ by 2½ by ¼ inches, to a depth of 12 to 14 feet with the tops not more than 1 foot nor less than 0.5 foot above the low-flow water surface.

2. Stretch two strands of No. 9 galvanized wire from post to post along the inboard face of the angle iron. One wire should be near the top of the post and the second about 1 foot lower (even if this is below the streambed elevation). Use 10-gage wire to fasten these two strands to the post.

3. Stretch 1-inch-mesh chicken wire 1.5 feet wide along the upstream face of the angle iron. Securely fasten the chicken wire to the angle iron and the galvanized wire.

4. Fasten angle-iron ribs, 2½ by 2½ by ¼ inches, along the tops of the jetted angle-iron posts.

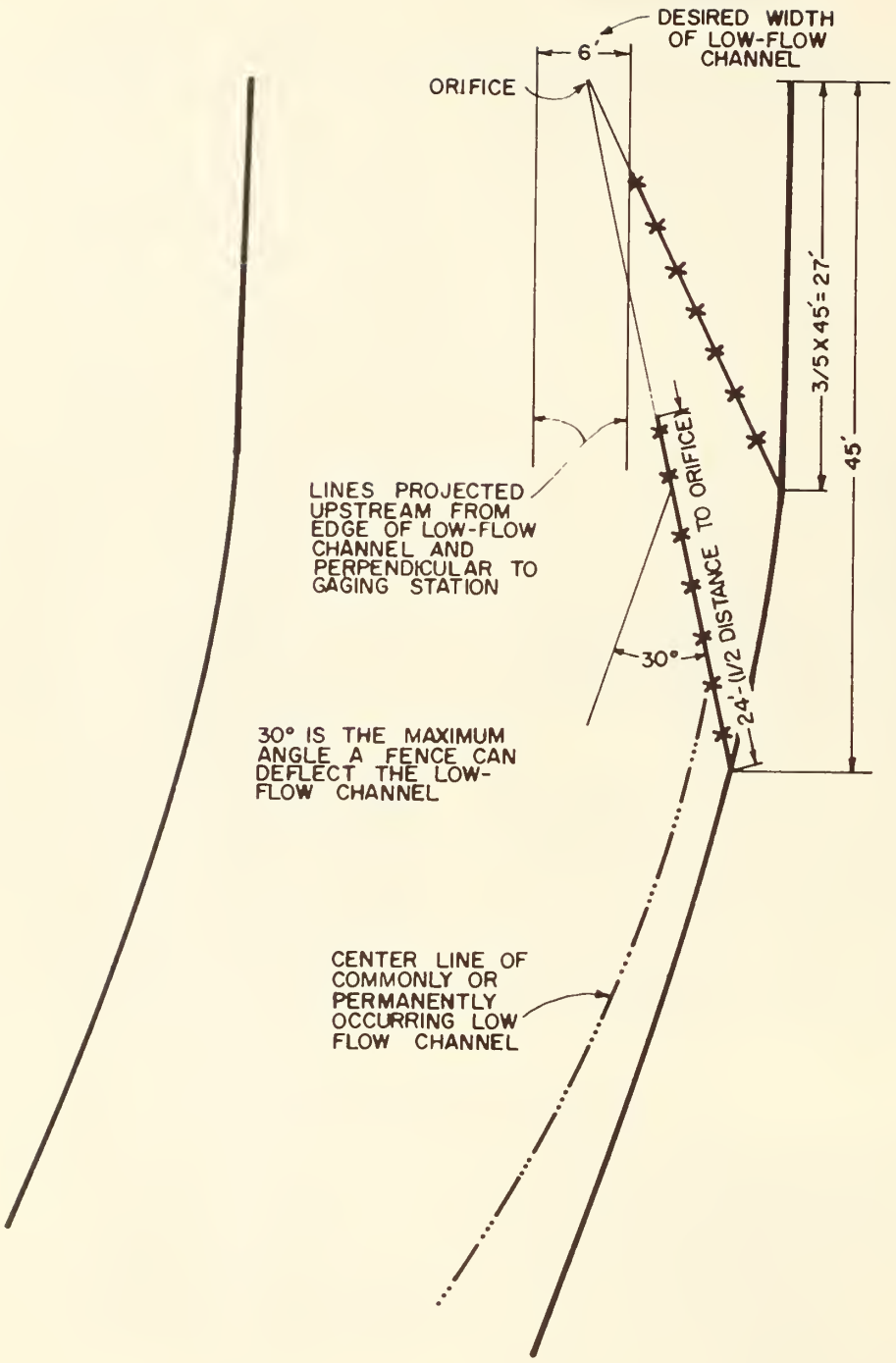

Figure 4.–Example of the location and construction of training fences on one side of the channel

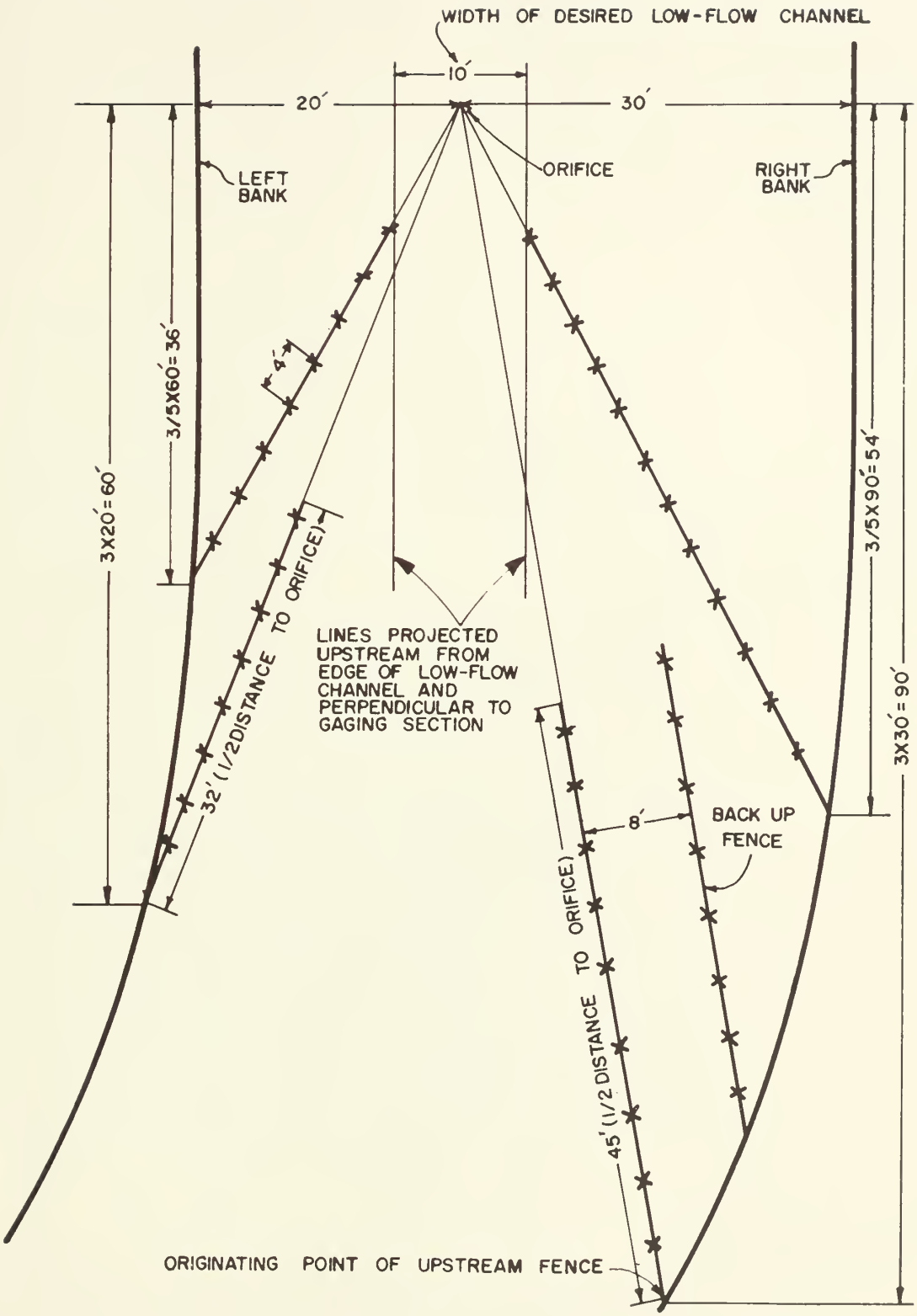

Figure 5.–Example of the location and construction of training fences on both sides of the channel.

COST OF INSTALLATION

Construction cost, based on the prices listed below, was about $1.50 per foot of fence.

Price List For Materials

Angle iron, 2½ by 2½ by ¼ inches	$0.25 per ft.
Labor	2.50 per hr.
Wire, No. 9 galvanized	.18 per lb.
Wire, No. 10 galvanized : (used to fasten No. 9 wire to posts)	.22 per lb.
Wire, galvanized (18-inch chicken wire, 1-inch mesh)	4.77 per 100 ft.

Cost For a 100-Foot Training Fence

Labor - 9 man-hours	$22.50
Angle iron - 464 ft.	116.00
Chicken wire - 104 ft.	4.96
No. 9 galvanized wire - 15 lbs.	2.70
No. 10 galvanized wire - 4 lbs.	.88
Total	$147.04

The only equipment needed for installation is a portable pump with about 80 gallons per minute capacity and a hose. A 12-foot piece of 1¼-inch pipe may be used as the jet pipe.

SUMMARY

1. More accurate low-flow records with less labor and expense can be obtained by using training fences to control the low flow of sandy-bottom streams.

2. The cost of these fences is about $1.50 per foot.

3. Properly installed training fences have no visible effect on the stream during high flows.